

WE CLAIM:

1. An adapter for connecting a vacuum source to a breast shield with tubing comprising:

5 a housing attachable to the vacuum source including an internal chamber in communication with the vacuum source;

one or more female coupling components, each of said one or more female coupling components defined by an interior sidewall surface of said housing, said interior sidewall surface including an upper portion with a first sidewall diameter and a lower portion with a second sidewall diameter, and a rim portion between said
10 upper portion and said lower portion connecting said upper portion and said lower portion, said second sidewall diameter being less than said first sidewall diameter, said lower portion including one or more ports formed therein allowing communication of said female coupling component with said internal chamber, and one or more channels
15 formed therein communicating with an opening in said rim portion; and

one or more male coupling components, each of said one or more male coupling components including a first end, a second end, and a passageway extending between said first end and said second end, said first end being sized and shaped to be attached to the tubing, said second end being sized and shaped to be received in one of
20 said one or more female coupling components and having a first end diameter, each of said one or more male coupling components further including a sealing portion between said first end and said second end, said sealing portion having a sealing surface formed about a periphery thereof, said sealing portion having a second end diameter, said second end diameter being greater than said first end diameter, said sealing portion
25 being sized and shaped to be received in said upper portion of said female coupling component such that said connector sealing surface is in a substantially airtight engagement with said interior sidewall surface.

2. The adapter of claim 1 wherein said channel is formed axially along said lower portion.
3. The adapter of claim 1 wherein said one or more female coupling components is
5 further defined by a bottom surface of said housing.
4. The adapter of claim 3 wherein said bottom surface includes one or more grooves formed therein communicating with said one or more channels.
- 10 5. The adapter of claim 3 wherein said lower portion includes three of said one or more channels formed axially in said lower portion of said interior sidewall surface, said three channels being evenly spaced about said periphery of said lower portion of said interior sidewall surface, and said bottom surface includes three grooves formed radially
15 therein, said grooves in said bottom surface being in respective communication with said one or more channels in said lower portion of said interior sidewall surface.
6. The adapter of claim 1 wherein two of said one or more female coupling components are provided thereon, and two of said one or more male coupling components are provided to be received in said female coupling components, and
20 further including a stopper, said stopper being sized and shaped to sealably engage said upper portion of either of said two coupling components.
7. The adapter of claim 6 wherein said stopper includes an aperture formed therein such that when said stopper is engaged with said female coupling component, said
25 aperture extends between ambient atmosphere and said female coupling component.
8. The adapter of claim 1 wherein said upper portion includes a generally circular axial cross-section.

9. The adapter of claim 8 wherein said sealing portion includes a generally circular axial cross-section sized and shaped to match said cross-section of said upper portion.

5 10. The adapter of claim 1 wherein said upper portion includes a generally polygonal axial cross-section.

10 11. The adapter of claim 10 wherein said sealing portion includes a generally polygonal axial cross-section sized and shaped to match said cross-section of said upper portion.

12. The adapter of claim 1 wherein said upper portion includes a generally triangular axial cross-section, said upper portion having three arcuate sides.

15 13. The adapter of claim 12 wherein said sealing portion includes a generally triangular axial cross-section, said sealing portion including three arcuate sides, said sealing portion being sized and shaped to match said cross-section of said upper portion.

20 14. The adapter of claim 1 wherein said sealing portion includes at least one circumferential ring integrally molded thereon.

25 15. The adapter of claim 14 wherein said upper portion includes at least one circumferential groove therein, said circumferential ring being sized and shaped to sealably engage with said circumferential groove when said sealing portion is received in said upper portion.

16. The adapter of claim 1 wherein the vacuum source is a piston pump having a piston cylinder, and a piston, said piston being disposed in said piston cylinder, said adapter is in the form of a cylinder holder which is received on an output end of said piston cylinder, said piston pump generating an intermittent vacuum through

5 reciprocation of said piston with an interior of said piston cylinder, said piston cylinder having an end through which said piston extends in use.

17. The adapter of claim 1 wherein said second end of said male coupling component is sized and shaped to be received in said lower portion and in the breast
10 shield.

18. An improved breast pump assembly comprising:

a vacuum source;

a tube;

15 one or more milking units including a breast shield which is adapted to receive a woman's breast therein for expression of milk, a container for expressed milk which is in fluid communication with said breast shield, and a tube attaching means for attaching said tube thereto, said tube attaching means being in communication with said breast shield; and

20 an adapter for connecting said vacuum source to said breast shield with said tube such that intermittent vacuum can thereby be generated in said breast shield to effect the expression of milk from a breast, said adapter including a housing attachable to said vacuum source including an internal chamber in communication with said vacuum source, one or more female coupling components, each of said one or
25 more female coupling components defined by an interior sidewall surface of said housing, said interior sidewall surface including an upper portion with a first sidewall diameter, a lower portion with a second sidewall diameter, and a rim portion between said upper and lower portions connecting said upper and lower portions, said rim portion having an opening therein, said second sidewall diameter being less than said

first sidewall diameter, said lower portion including one or more ports formed therein allowing communication of said female coupling component with said internal chamber, and one or more channels formed therein communicating with said opening in said rim portion, and one or more male coupling components, each of said one or more male coupling components having a first end, a second end, and a passageway extending between said first end and said second end, said first end being sized and shaped to be attached to said tube, said second end being sized and shaped to be received in one of said one or more female coupling components and having a first end diameter, each of said one or more male coupling components further including a sealing portion between said first end and said second end, said sealing portion having a connector sealing surface formed about a periphery thereof, said sealing portion having a second end diameter, said second end diameter being greater than said first end diameter, said sealing portion being sized and shaped to be received in said upper portion of said female coupling component such that said sealing surface is in a substantially airtight engagement with said interior sidewall surface.

19. The breast pump assembly of claim 18 wherein said channel is formed axially along said lower portion.

20. The breast pump assembly of claim 18 wherein said one or more female coupling component is further defined by a bottom surface of said housing.

21. The breast pump assembly of claim 20 wherein said bottom surface includes one or more grooves radially formed therein communicating with said one or more channels.

22. The breast pump assembly of claim 21 wherein said lower portion includes three channels formed axially in said lower portion of said interior sidewall surface, said channels being evenly spaced about the periphery of said lower portion of said interior sidewall surface, and said bottom surface includes three grooves formed radially therein, said grooves in said bottom surface being in respective communication with said channels in said lower portion of said interior sidewall surface.

23. The breast pump assembly of claim 18 wherein two female coupling components are provided on said adapter, and two male coupling components are provided to be received in said female coupling components, and further comprising a stopper, said stopper being sized and shaped to sealably engage said upper portion of either of said two coupling components.

24. The breast pump assembly of claim 23 wherein said stopper has an aperture formed therein such that when said stopper is engaged with said female coupling component, said aperture extends between ambient atmosphere and said female coupling component, said aperture being adapted to regulate vacuum pressure when only a single coupling component is in use, such that the vacuum generated is essentially equal for a given piston stroke whether one or both of said coupling components are being used.

25. The breast pump assembly of claim 18 wherein said upper portion includes a generally circular axial cross-section.

26. The breast pump assembly of claim 25 wherein said sealing portion includes a generally circular axial cross-section sized and shaped to match said cross-section of said upper portion.

27. The breast pump assembly of claim 18 wherein said upper portion includes a generally polygonal axial cross-section.

5 28. The breast pump assembly of claim 27 wherein said sealing portion includes a generally polygonal axial cross-section sized and shaped to match said cross-section of said upper portion.

10 29. The breast pump assembly of claim 18 wherein said upper portion includes a generally triangular axial cross-section, said upper portion having three arcuate sides.

30. The breast pump assembly of claim 29 wherein said sealing portion includes a generally triangular axial cross-section, said sealing portion having three arcuate sides, said sealing portion being sized and shaped to match said cross-section of said upper portion.

15 31. The breast pump assembly of claim 18 wherein said sealing portion includes at least one circumferential ring integrally molded thereon.

20 32. The breast pump assembly of claim 31 wherein said upper portion includes at least one circumferential groove therein, said circumferential ring being sized and shaped to sealably engage with said circumferential groove when said sealing portion is received in said upper portion.

33. The breast pump assembly of claim 18 wherein said source of intermittent vacuum is a piston pump, said piston pump having a piston cylinder and a piston, said piston being disposed in said piston cylinder, said adapter sized and shaped as a cylinder holder which is received on an output end of said piston cylinder, said piston
5 pump generating an intermittent vacuum through reciprocation of said piston with an interior of said piston cylinder, said piston cylinder having an end through which said piston extends in use.

34. The breast pump assembly of claim 18 wherein said second end of said male
10 coupling component is sized and shaped to be received in said lower portion, and on said tube attaching means.

35. An adapter for connecting a vacuum source to a breast shield with intermittent vacuum thereby being generated in said breast shield to effect expression of milk from a breast, comprising:

15 a housing attachable to the vacuum source including an internal chamber in communication with said vacuum source;

one or more female coupling components, each of said one or more female coupling components defined by an interior sidewall surface of said housing, said interior sidewall surface including an upper portion with a first sidewall diameter
20 and a lower portion with a second sidewall diameter, and a rim portion between said upper and lower portions connecting said upper and lower portions, said second sidewall diameter being less than said first sidewall diameter, said lower portion including one or more ports formed therein allowing communication of said female coupling component with said internal chamber, and one or more channels formed
25 therein communicating with an opening in said rim portion; and

one or more male coupling components, each of said one or more male coupling components including a first end, a second end, and a passageway extending between said first end and said second end, said first end being sized and shaped to be attached to a tubing, said second end being sized and shaped to be received in one of

said one or more female coupling components and having a first end diameter, each of said one or more male coupling components further including a sealing portion between said first end and said second end, said sealing portion having a sealing surface formed about the periphery thereof, said sealing portion having a second end diameter, said
5 second end diameter being greater than said first end diameter, said sealing portion being sized and shaped to be received in said upper portion of said female coupling component such that said sealing surface is in a substantially airtight engagement with said interior sidewall surface, said sealing portion having at least one circumferential ring integrally molded thereon; and

10 a stopper, said stopper being sized and shaped to be received in said upper portion of said female coupling component such that said stopper is in a substantially airtight engagement with said interior sidewall surface.

15 36. The adapter of claim 35 wherein said channel is formed axially along said lower portion.

37. The adapter of claim 33 wherein said one or more female coupling component is further defined by a bottom surface of said housing.

20 38. The adapter of claim 37 wherein said bottom surface includes one or more grooves formed radially therein communicating with said one or more channels.

25 39. The adapter of claim 38 wherein said lower portion includes three of said one or more channels formed axially in said interior sidewall surface, said three channels being evenly spaced about said lower portion of said interior sidewall surface, said bottom surface includes three grooves formed radially therein, each of said grooves in said bottom surface being in respective communication with each of said three channels in said lower portion of said interior sidewall surface.

40. The adapter of claim 35 wherein two female coupling components are provided thereon for receiving a respective male coupling component, and further including a stopper, said stopper being sized and shaped to sealably engage said upper portion of either of said two female coupling components.

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41. The adapter of claim 40 wherein said stopper includes an aperture formed therein such that when said stopper is engaged with said female coupling component, said aperture extends between ambient atmosphere and said female coupling component, said aperture being adapted to regulate vacuum pressure when only a single coupling component is in use, such that the vacuum generated is essentially the same for a given piston stroke whether one or both coupling components are being used..

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42. The adapter of claim 35 wherein said upper portion includes a generally circular axial cross-section.

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43. The adapter of claim 42 wherein said sealing portion includes a generally circular axial cross-section sized and shaped to match said cross-section of said upper portion.

44. The adapter of claim 35 wherein said upper portion includes a generally polygonal axial cross-section.

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45. The adapter of claim 44 wherein said sealing portion includes a generally polygonal axial cross-section sized and shaped to match said cross-section of said upper portion.

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46. The adapter of claim 35 wherein said upper portion includes a generally triangular axial cross-section, said upper portion having three arcuate sides.

47. The adapter of claim 46 wherein said sealing portion includes a generally triangular axial cross-section, said sealing portion having three arcuate sides, said sealing portion being sized and shaped to match said cross-section of said upper portion.

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48. The adapter of claim 35 wherein said upper portion includes at least one circumferential groove therein, said circumferential ring being sized and shaped to sealably engage with said circumferential groove when said sealing portion is received in said upper portion.

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49. The adapter of claim 35 wherein said vacuum source is a piston pump including a piston cylinder, and a piston, said piston being disposed in said piston cylinder, said adapter sized and shaped as a cylinder holder which is received on an output end of said piston cylinder, said piston pump generating an intermittent vacuum through reciprocation of said piston with interior of said piston cylinder, said piston cylinder having an end through which said piston extends in use.

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50. The adapter of claim 35 wherein said second end of said male coupling component is sized and shaped to be received in said lower portion, and on the breast shield.

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